

Please replace paragraph (20) with the following amended paragraph:

(20) Referring to Figs. 1 and 2, the present disclosure provides a mass flow ratio system 10 and method ~~1228~~ for dividing a single mass flow into a desired ratio of two or more mass flows. The system 10 and method ~~1228~~ are particularly intended for use with gas metering systems for delivering contaminant-free, precisely metered quantities of process and purge gases to semiconductor process chambers. The presently disclosed system 10 and method ~~1228~~ provide the benefit of operating independently of the gas or gases controlled, and of operating without disturbing the performance of any upstream mass flow controllers.

Please replace paragraph (25) with the following amended paragraph:

(25) Referring to Fig. 8, an existing flow dividing system 210 is shown. The system 210 is described in greater detail in co-pending U.S. patent application serial number 09/836,748, filed April 17, 2001, now U.S. Patent No. 6,418, 954, which issued on July 16, 2002, is assigned to the assignee of the present invention and is incorporated in its entirety herein by reference (attorney docket number MKS-86). The system 210 includes an inlet line or manifold 212 for receiving the single gas flow from the outlet manifold 128 of the gas box 110, and first and second flow lines 214, 216 connected to the inlet 212. A mass flow meter 218 measures gas flow through the first line 214 and provides a signal indicative of the measured flow rate. A restrictor 220 restricts gas flow through the first line 214 to a desired flow rate, and has a smallest cross-sectional flow area selected to provide an upstream pressure high enough to allow the mass flow meter 218 to operate properly and lower than a predetermined upper pressure limit. The system also has a mass flow controller 222 controlling gas flow through the second line 216. The mass flow controller 222 receives the signal indicative of the measured flow rate from the mass flow meter 218 and maintains a flow rate through the second line 216 based on the signal.

Please replace paragraph (27) with the following amended paragraph:

(27) Referring again to Fig. 1, the presently disclosed mass flow ratio system 10 includes an inlet line or manifold 12 for receiving the single gas flow from the outlet manifold 128 of the gas box 110, and first and second flow lines 14a, 14b connected to the inlet 12. Each line 14a, 14b is provided with a mass flow meter 18a, 18b measuring mass flow through the line and providing a signal indicative of the measured flow, and a valve 20a, 20b controlling flow through the line based on a signal indicative of a desired flow ratio setting. The ratio system 10 also has a user interface 22 for receiving a desired flow ratio, and a controller 24 connected to the flow meters 18a, 18b, the valves 20a, 20b and the user interface 22. The flow ratio " α " is defined herein as the flow " Q_2 " through the second line 14b divided by the flow " Q_1 " through the first line 14a.

Please replace paragraph (34) with the following amended paragraph:

(34) In the embodiment of Fig. 56, the user interface 24 is preferably adapted to receive a desired ratio of flow for the second and the first flow lines 14b, 14a, and a desired ratio of flow for the third and the first flow lines 14c, 14a (i.e., " α_1 " = " Q_2 " / " Q_1 " and " α_2 " = " Q_3 " / " Q_1 "). The controller 24 is programmed to provide a signal to the valve 20a of the first line 14a indicative of a first desired flow, thereby making the valve 20a a fixed orifice. Preferably, the valve 20a is fully opened. The controller 24 then receives the desired ratios of flow through the user interface 22, receives the signals indicative of measured flow from the flow meters 18a, 18b, calculates an actual ratio of flow for the second and the first flow lines 14b, 14a based upon the measured flows through the second and the first flow lines, calculates a second desired flow if the actual ratio for the second and the first flow lines is unequal to the desired ratio for the second and the first flow lines, and provides a signal to the valve 20b of the second flow line 14b indicative of the second desired flow.

Please replace paragraph (36) with the following amended paragraph:

(36) Although not shown, the mass flow ratio systems 10, 30 can be provided with more than three flow lines 14, with each additional flow line having a valve 20 and a flow meter

18 connected to the controller 24. In addition, it is envisioned that a mass flow controller can be used as the mass flow meter and the valve of each line. Although not shown, it is envisioned that the disclosed ratio systems 10, 30 each can be provided as a modular unit for quick and easy assembly between a gas box and a process chamber(s). In such a case, a shut-off valve or suitable connector ~~50~~150 might be provided between the inlet manifold 12 of the ratio systems 10, 30 and the outlet manifold 128 of the gas box 110, as shown in Figs. 1 and ~~5~~6.

Please replace paragraph (37) with the following amended paragraph:

(37) Embodiments of a system and a method for dividing flow according to the present invention can further include a pressure sensor for the inlet 12 and/or outlets of the systems ~~system~~ 10 and 50. The inlet pressure and/or the outlet pressure measurement provided by the pressure sensor(s) is used by the controller 24 to not only control the ratio " α " of the flows, but also control the inlet pressure and/or the outlet pressures.

Please replace paragraph (38) with the following amended paragraph:

(38) Adding a pressure control feature has a number of ancillary benefits, including improving the ~~system~~ performance of each system 10 and 50 and reducing disturbances to devices upstream or downstream of each of the systems ~~system~~ 10 and 50. By operating each of the systems ~~system~~ 10 and 50 at the maximum allowable pressures, the need for factors of safety in the ratio control system can be removed or reduced. In addition, controlling the pressure drop across the valves 20a, 20b improves valve performance and makes valve setup, matching, and tuning more simple. The present disclosure is intended, therefore, ~~intended~~ to include a system and a method for dividing flow, with any added pressure control features. For example, the present disclosure ~~may is intended to~~ include the flow divider system 10 or 50, plus a pressure sensor(s) (not shown) in the inlet and/or the outlets of the system. The present disclosure ~~may is~~ also ~~intended to~~ include a method ~~1228~~ of dividing flow plus measuring pressure(s) in the inlet

A) ~~an the system~~ inlet adapted to receive the single mass flow, ~~wherein the inlet is free of any flow meters for providing a measurement of flow through the inlet;~~

B) at least two of the secondary flow lines connected to the inlet, each secondary flow line including,

a flow meter measuring flow through the secondary flow line and providing a signal indicative of the measured flow, and

a valve controlling flow through the secondary flow line based upon a signal indicative of desired flow rate through the secondary flow line;

C) a user interface adapted to receive ~~at least one desired ratio of flow~~ the setting of the preselected ratio of flows; and

D) a controller connected to each of the flow meters; and the valves of the secondary flow lines, and the user interface, and programmed to,

receive through the user interface, the desired setting of the preselected ratio of flows through the ~~user interface~~ secondary flow lines,

receive the signals indicative of measured flow from the flow meters of each of the secondary flow lines,

calculate an actual ratio of flow through the flow lines based upon the measured flow, wherein said calculation is made without reference to the total flow received at the inlet, nor to the sum total of the secondary flows through the secondary flow lines ~~a measured flow through the inlet,~~

compare the actual ratio to the desired ratio,

and/or the outlets. In effect, the present application ~~may is meant to~~ include any control methodologies using pressure measurements for the claimed flow dividing system and method.

Please replace paragraph (39) with the following amended paragraph:

(39) The following example is made with reference to Fig. 1. Assuming the addition of a pressure sensor (not shown) on the inlet 12 of the mass flow ratio system 10, the controller 24 is programmed to take three inputs: the flow "Q₂" through the second line 14b; the flow "Q₁" through the first line 14a; and a measured pressure "P_{in}" at the inlet 12 as provided by the pressure sensor (not shown). The controller 24 is programmed to issue commands to both of the first and the second valves 20a, 20b dynamically, instead of just controlling one valve at a time. However, in terms of ratio control, the "fixed valve" is mostly open, while the ratio is determined by controlling the other valve between 10% and 50% of a control range of the valve. With the addition of the pressure signal the fixed valve is set to control the inlet pressure, and the other valve is used to control the flow ratio. An example of an inlet pressure control could be written as:

$$V_{c1} = K_{pa}(\alpha - \alpha_{sp}) + K_{ia} \int (\alpha - \alpha_{sp}) dt$$

$$V_{c2} = K_{pp}(P_{in} - P_t) + K_{ip} \int (P_{in} - P_t) dt$$

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently amended) A system for dividing a single mass flow from a system inlet into two or more secondary flows through two or more secondary flow lines in accordance with a preselected ratio of flow rates through the secondary flow lines, ~~each having of desired ratios,~~ comprising: